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ANALYSIS OF HEALTH STATUS FROM PRELIMINARY PHYSICAL EXAMINATION OF FLIGHT ACADEMY APPLICANTS

by

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ANALYSIS OF HEALTH STATUS FROM PRELIMINARY PHYSICAL EXAMINATIONS OF FLIGHT ACADEMY APPLICANTS

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In March 1985, flight academy applicants selected from eight middle schools received physical examinations in Gong'an County. These students were male students in the graduating classes of these senior middle schools. According to physical examinations standards for flight academy applicants in the Chinese People's Liberation Army as promulgated in 1985 by the Central Military Commission, the practice of single-item disqualification was adopted. Four hundred sixteen persons underwent physical examinations, with ages between 16 and 19 with the following number and age percentages: two 16-year-olds, 0.48 percent; thirty-three 17-year-olds, 7.93 percent; two hundred seventy-three 18-year-olds, 65.63 percent; and one hundred eight 19-year-olds, 25.96 percent.

Analysis of the Results of the Physical Examinations

One hundred forty-nine were qualified at the preliminary physical examinations; two hundred sixty-seven persons were disqualified (267/416), for an overall disqualification percentage of 64.18 percent. In the category of five organs (two eyes, two ears and one mouth), persons with subnormal vision (unaided vision in either eye is lower than 1.0) accounted for 73.64 percent (109/148); persons who were color-blind (including weak color vision) accounted for 8.78 percent (13/148); persons with rhinitis represented 6.08 percent (9/148); persons with scabies accounted for 22.35 percent (19/85); persons with subnormal body weight represented 17.64 percent (15/85); persons with subnormal height accounted for 16.47 percent (14/85); in the internal medicine category, persons with above-normal rate of heart beat accounted for 44.11 percent (15/34); persons with higher than normal blood pressure represented 35.29 percent (12/34); and persons with enlarged liver accounted for 17.64 percent (6/34).

Of these above-mentioned causes for disqualification in the physical examinations, most persons were disqualified because of subnormal eye vision, 40.82 percent of all those disqualified (109/267). In a follow-up investigation, it was found that in general there is substandard classroom lighting below the normal illumination levels regulated by the Ministry of Public Health. These subnormal illumination levels have affected student visual acuity in varying degrees. In addition, unsupervised student study time came to long hours every night, usually 3 to 4 hours; this is also a factor that cannot be neglected, in causing poor vision. Next, persons with scabies were amounted to 7.11 percent of all students (19/267). It is understood that dormitory conditions are undesirable; there are water shortage in general since students do not have their bathrooms. In most schools, two students share a bed, thus spreading scabies.

To improve student body constitution, schools should emphasize education in student health maintenance and public health by paying attention to keeping their eyes healthy as well as eye exercises. In addition, the administrative departments of schools should be made aware of improving study environments in school along with health facilities.

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EVALUATION OF DISTRIBUTION CORRELATION OF BIOLOGICAL MATERIAL TEST DATA

Wang Weijing and Liao Jianhua

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EVALUATION OF DISTRIBUTION CORRELATION OF BIOLOGICAL MATERIAL TEST DATA

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Among the methods of finding the frequency distribution of test data, generally the positive D test, skewness-kurtosis test, and probability graph method are used, among others. These methods have shortcomings, as follows: too many steps require a large amount of computation; or else, the efficiency of determination is low; or else, the accuracy is low. Thus, the authors adopted correlation analysis [1] in the gray system theory. The authors propose to establish a method of evaluating the determination of data distribution with simple computation, accurate results, and relatively high discrimination capability.

(A) Procedures and steps in correlation analysis

In correlation analysis under the gray system, correlation coefficients are used to evaluate the method of analyzing the specimens to be determined. Which object with known distribution data is the closest? Which correlation coefficient is the largest for the specimen being determined into which distribution category of distribution? For example, there is a set of data from analyses of fluorine content in urine samples as listed in Table 1. Also listed in Table 1 are four types of known frequency distributions with the same set number as the above mentioned example. Then, the following steps are executed.

1. Derive the frequency composition ratios of the various items as listed in Table 2.

2. Derive the differences between the distribution of the object to be determined and the composition ratio of the known distribution frequency, as listed in Table 3.

3. Solve for the correlation coefficient R [2, 3] by using the following equation, Eq. (1):

$$R_i = \frac{1}{n}\sum \frac{\min\limits_{i}\ \min\limits_{K}\left|x_0(K)-x_i(K)\right| + \frac{1}{2}\max\limits_{i}\ \max\limits_{K}\left|x_0(K)-x_i(K)\right|}{\left|x_0(K)-x_i(K)\right| + \frac{1}{2}\max\limits_{i}\ \max\limits_{K}\left|x_0(K)-x_i(K)\right|} \quad (1)$$

Note: $\min\limits_{K}$ is the smallest number in the sequence

$\max\limits_{K}$ is the largest number in the sequence

Table 1. Frequency Distribution (to be Determined) of Analytical Data of Fluorine in Urine Samples, and Frequency Data for Four Known Distributions

a 数据分布	分 b 组 mg/L								
	~0.1	~0.4	~0.8	~1.2	~1.6	~2.0	~2.4	~2.8	~3.2
c 待辨 $x_0(K)$	0	15	80	67	39	16	7	7	3
d 威布尔 $x_1(K)$	0	5	15	25	35	45	55	65	75
e 正态 $x_2(K)$	5	10	25	35	45	35	25	10	5
f 负偏态 $x_3(K)$	1	6	16	26	36	46	56	40	30
g 正偏态 $x_4(K)$	20	40	60	50	40	30	20	10	4

Key: a. Data distribution b. Division of sets c. To be determined d. Weibull e. Positive state f. Negative skewness g. Positive skewness.

Table 2. Frequency Composition Ratios of Various Items

分 组 (a)	1	2	3	4	5	6	7	8	9
$x_0(K)$	0	0.06	0.34	0.29	0.17	0.07	0.03	0.03	0.01
$x_1(K)$	0	0.02	0.05	0.08	0.11	0.14	0.17	0.20	0.23
$x_2(K)$	0.02	0.05	0.13	0.18	0.23	0.18	0.13	0.05	0.02
$x_3(K)$	0.004	0.02	0.06	0.10	0.14	0.18	0.22	0.16	0.12
$x_4(K)$	0.07	0.15	0.22	0.18	0.15	0.11	0.07	0.04	0.01

Key: a. Division of sets.

Table 3. Differences Between the Distribution Under Determination, and Frequency Composition Ratios of Known Distribution

分 组 (a)	1	2	3	4	5	6	7	8	9	min K	max K
$\lvert x_0(K)-x_1(K)\rvert$	0	0.04	0.29	0.21	0.06	0.07	0.14	0.17	0.22	0	0.29
$\lvert x_0(K)-x_2(K)\rvert$	0.02	0.01	0.21	0.11	0.06	0.11	0.10	0.02	0.01	0.01	0.21
$\lvert x_0(K)-x_3(K)\rvert$	0.004	0.04	0.28	0.19	0.03	0.11	0.19	0.13	0.11	0.004	0.28
$\lvert x_0(K)-x_4(K)\rvert$	0.07	0.09	0.12	0.11	0.02	0.04	0.04	0.01	0	0	0.12

Key: a. Division of sets.

Table 4. Frequency Distribution of Analytical Data for 20 Sets

a 序号	b 资料名称	c 分组								
		1	2	3	4	5	6	7	8	9
1	血氟(女)	9	26	67	18	22	5	2	1	1
2	尿δ-ALA	0	70	168	99	62	39	21	4	0
3	尿酚	48	118	147	92	62	35	19	7	2
4	血醛固酮	0	260	464	293	106	139	70	0	0
5	血C(尘肺)	3	23	36	20	17	9	4	2	2
6	血C	2	5	11	20	36	23	12	6	1
7	SGPT(动物)	2	5	6	11	18	28	35	26	24
8	血ChE(女)	2	8	17	26	38	23	16	7	1
9	血ChE(男)	6	17	27	36	49	38	22	16	3
10	血压(异常)	0	0	4	14	17	32	103	250	300
11	RBC(男)	4	9	16	22	25	21	17	9	4
12	RBC(女)	5	8	16	35	25	8	2	1	0
13	血钠	1	1	3	9	14	12	10	1	1
14	发锰	51	61	63	39	16	6	12	8	6
15	发锰(冶炼工)	14	49	29	15	16	8	5	1	2
16	17酮类固醇	4	9	15	28	22	17	8	2	1
17	血氟(男)	7	44	64	23	20	8	4	1	0
18	IgG	7	16	23	44	48	37	38	28	20
19	IgA	1	9	21	58	59	46	42	23	8
20	补体C_3	8	53	59	50	37	29	25	14	2

Key: a. Sequence number b. Name of material c. Division of sets
[Vertical column of numbers at the left side of table are used as keying numbers -- translator] 1. Blood fluorine (female) 2. Urine delta-ALA 3. Urine phenol 4. Blood aldehyde solid acetone 5. Blood C (dust in lung) 6. Blood C 7. SGPT (animal) 8. Blood ChE (female) 9. Blood ChE (male) 10. Blood pressure (abnormal) 11. RBC (male) 12. RBC (female) 13. Blood sodium 14. Manganese 15. Manganese (refinery worker) 16. 17-acetone sterol 17. Blood fluorine (male) 18. IgG 19. IgA 20. Complement C_3.

4. Results: R_4 is the largest; that is, correlation of $x_0(K)$ and $x_4(K)$ is the closest. Therefore, the data for the fluorine content in urine to be determined has a distribution of positive skewness. From this determination data, let us compute skewness-kurtosis [4] by using the dynamic error of the first four levels, and we obtain the following: $t_{g_1}=7.197\,5$, $P<0.001$; $tg_1=4.418\,5$, $P<0.001$. This is positive skewness.

Table 5. Results of Four Ways of Evaluating the Data Distribution of 20 Data Sets

a 序号	b 关联分析		c 正态性D检验▲		d 偏度-峰度检验		结果 e	f 威布尔概率纸结果
	g 最大R值	结果 e	D h值	e 结果	t_{s1}	t_{s2}		
1	R,0.819 7	④	0.259 88	④	4.961 5	4.784 5	④	—
2	R,0.781 7	④	0.270 47	④	6.910 6	0.134 8	④	—
3	R,0.807 1	④	0.273 68	④	6.755 0	1.024 9	④	—
4	R,0.739 8	④	0.270 57	④	12.393 3	−1.729 6	④	—
5	R,0.825 7	④	0.269 24	④	4.020 1	1.674 6-	④	—
6	R,0.840 9	②	0.275 28	②	−0.547 2	0.191 9	②	—
7	R,0.885 8	③	0.281 09	②	−3.099 3	−2.165 5	③	—
8	R:0.892 5	②	0.281 37	②	−0.058 4	−0.746 7	②	—
9	R,0.946 0	②	0.281 68	②	−0.130 4	−1.579 6	②	—
10	R,0.765 6	①	—	—	—	—	—	①
11	R:0.957 3	②	0.282 74	②	−0.020 4	−1.361 7	②	—
12	R,0.761 4	②	0.270 60	④	−0.487 1	0.872 2	②	—
13	R:0.769 2	②	0.273 28	②	−0.948 1	0.830 9	②	—
14	R,0.758 5	④	0.260 46	④	8.738 2	4.398 5	④	—
15	R,0.804 5	④	0.275 53	④	2.903 8	0.427 7	④	—
16	R:0.830 9	②	0.279 53	②	−0.236 4	−0.804 5	②	—
17	R,0.792 7	④	0.265 87	④	4.743 7	1.746 6	④	—
18	R:0.793 8	②	0.283 85	③	- 0.467 4	−2.425 0	②	—
19	R:0.861 1	②	0.281 80	②	0.976 7	−2.136 2	②	—
20	R,0.901 7	④	0.280 28	②	3.335 9	−2.205 9	④	—

Key: a. Number in sequence b. Correlation analysis c. Positive D test▲ d. Skewness-kurtosis test e. Results f. Results of Weibull plot g. Largest R value h. D value

Legend: 1. Weibull distribution 2. Positive distribution 3. Negative skewness 4. Positive skewness "-" Incomplete ▲ Simplified (at Huaxi Medical University) D' Agostino examination method.

(B) Verification of effects

To verify the accuracy of this method as a subsequent step, the authors employed correlation analysis in discriminating the 20 sets of frequency distribution data for the analytical data (Table 4). Moreover, the symbols used are as follows: R_i is the correlation coefficient of any item; n is number of sets; $\min_i \min_K$ are the minimum of all number sequences (row and column);

$\max\limits_i \max\limits_K$: are the maximum of all number sequences (row and column).

In this example: $\min\limits_i \min\limits_K \left| x_0(K) - x_i(K) \right| =$

$= 0$; $\max\limits_i \max\limits_K \left| x_0(K) - x_i(K) \right| =$

$= 0.29 \quad n = 9$

By insertion in Eq. (1), we obtain the following:

$$R_i = \frac{1}{9}\sum\left[\frac{0+0.145}{|x_0(K)-x_i(K)|+0.145}\right] = \frac{1}{9}\sum\left[\frac{0.145}{|x_0(K)-x_i(K)|+0.145}\right] \qquad (2)$$

Insert the Table 3 data in Eq. (2); after performing the computations on a microcomputer, we obtain the following:

$R_1 = 0.581\,6$; $R_2 = 0.711\,7$; $R_3 = 0.614\,6$; $R_4 = 0.758\,1$.

Conduct a positive (simplified) D test, a skewness-kurtosis test, and a Weibull plot test. Except for the case of probability paper, all tests were done on a microcomputer. Carry out a comparative verification (Table 5). The verification results were found to be completely consistent with the correlation analysis and the skewness-kurtosis test. There were three errors in the positive (simplified) D test. In addition, this method is suitable for finding multiple-item distributions.

(C) Discussion and preliminary conclusions

From the determination procedures, it is known that the breakdown of the correlation analysis method is simple and clear; the computational load is low, and the results are accurate. The range of determination is relatively large. In fact, this method can be used to discriminate more than four distribution types; this fact is an advantage compared to conventional methods now in use. The authors realized that the known frequency distribution designed for correlation analysis should be standardized as far as possible. The numbers of sets and sections are consistent with the materials under determination, thus having good effects.

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